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ORIGINAL ARTICLE

Evaluation of the reliability and validity of the Italian version of the schema mode inventory for eating disorders: short form for adults with dysfunctional eating behaviors

Giada Pietrabissa[1,2] · Alessandro Rossi[3] · Susan Simpson[4,5] · Andrea Tagliagambe[2] · Venessa Bertuzzi[2] · Clarissa Volpi[2] · Giulia Fava[6] · Gian Mauro Manzoni[1,7] · Giovanni Gravina[6] · Gianluca Castelnuovo[1,2]

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Abstract

Purpose To examine the psychometric properties and the factorial structure of the Italian version of the schema mode inventory for eating disorders—short form (SMI-ED-SF) for adults with dysfunctional eating patterns.

Methods 649 participants (72.1% females) completed the 64-item Italian version of the SMI-ED-SF and the eating disorder examination questionnaire (EDE-Q) for measuring eating disorder symptoms. Psychometric testing included confirmatory factor analysis (CFA) and internal consistency. Multivariate analysis of covariance (MANCOVA) was also run to test statistical differences between the EDE-Q subscales on the SMI-ED-SF modes, while controlling for possible confounding variables.

Results Factorial analysis confirmed the 16-factors structure for the SMI-ED-SF [S–Bχ^2 (1832) = 3324.799; $p < .001$; RMSEA = 0.045; 90% CI 0.043–0.048; CFI = 0.880; SRMR = 0.066; $\chi^{2/df} = 1.81$; < 3]. Internal consistency was acceptable in all scales, with Cronbach's Alpha coefficients ranging from 0.635 to 0.873.

Conclusions The SMI-ED-SF represents a reliable and valid alternative to the long-form SMI-ED for assessment and conceptualization of schema modes in Italian adults with disordered eating habits. Its use is recommended for clinical and research purposes.

Level of evidence Level V, descriptive study.

Keywords Factorial structure · Psychometric properties · Schema therapy · Modes · Eating disorders

✉ Giada Pietrabissa
giada.pietrabissa@unicatt.it

Alessandro Rossi
rossi.alessandro@live.it

Susan Simpson
simpsosg@gmail.com

Andrea Tagliagambe
andrea.tagliagambe01@icatt.it

Venessa Bertuzzi
vany_87@icloud.com

Clarissa Volpi
clarissa.volpi@gmail.com

Giulia Fava
giulia.fava5@gmail.com

Gian Mauro Manzoni
gm.manzoni@auxologico.it

Giovanni Gravina
gravina@sanrossorecura.it

Gianluca Castelnuovo
gianluca.castelnuovo@unicatt.it

1 Istituto Auxologico Italiano, IRCCS, Psychology Research Laboratory, Milan, Italy

2 Department of Psychology, Catholic University of Milan, Milan, Italy

3 Department of Philosophy, Sociology, Education, and Applied Psychology, Section of Applied Psychology, University of Padua, Padua, Italy

4 School of Psychology, Social Work and Social Policy, University of South Australia, GPO Box 8 2471, Adelaide, South Australia 5001, Australia

5 Regional Eating Disorders Unit, NHS Lothian, St. John's Hospital, Livingston, Scotland, UK

6 Casa di Cura San Rossore, Pisa, Italy

7 Faculty of Psychology, eCampus University, Novedrate, Como, Italy

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Introduction

Eating disorders (EDs) are serious and difficult-to-treat mental illnesses, often showing ego-syntonic features and resistance to treatments. Epidemiological studies usually underestimate the occurrence of EDs in the general population, since individuals are rarely aware of their illness and only occasionally refer to mental health care [1]. Many factors conspire to impede the treatment of EDs, including entrenched thinking, ambivalence about change, avoidant and perfectionistic personality traits, and comorbidity of trauma symptoms [2, 3].

Cognitive behavioural therapy (CBT) is widely recognized as the treatment of choice for adults with EDs [4]. Despite the widespread support for its efficacy [5, 6], therapy is often hampered by the well-known phenomenon of dropout [5].

Schema therapy (ST) is an integrative and multi-modal approach developed to address deeper levels of cognition and entrenched behaviours that do not respond to first-line treatments [7].

The goal of the ST treatment for EDs is to enable core psychological (and physiological) needs to be met [8], and to bring about change in eating habits by breaking enduring and self-defeating patterns of thinking, feeling, and behaving that typically begin early in life as a result of the interaction between temperament and unmet core emotional needs—referred to as early maladaptive schemas (EMS)—whilst developing healthy coping mechanisms [9, 10]. Indeed, research, suggests that those who suffer from EDs experience significantly higher levels of maladaptive modes than community samples [11, 12]. The ST treatment for EDs includes recognizing and challenging Internalized Critic Modes, re-parenting to heal the vulnerable child mode, and bypassing the resulting coping modes that are linked to the over-evaluation of shape, weight, and self-starvation. Limits are also set on Angry and Impulsive Child Modes that drive a self-destructive "acting out" of needs (i.e., bingeing). Cognitive and behavioural techniques are considered core aspects of ST, but the model gives equal weight to emotion-focused work and experiential techniques, in addition to the basic healing components of the therapeutic relationship. As with CBT, ST is structured, systematic and specific, following a sequence of assessment and treatment procedures. However, the pace and emphasis on aspects of treatment may vary depending on the individual needs.

To facilitate more precise measurement of mode states within the ED population, the schema mode inventory for eating disorders (SMI-ED) was recently developed, showing adequate validity and reliability [13]. Given the large number of items in the SMI-ED ($n = 190$)—which make it cumbersome for everyday clinical practice—the purpose of the present study was to develop a shortened Italian version of the SMI-ED, to assess its psychometric proprieties, and to determine the internal reliability of its subscales. The relationship between ED symptoms (restraint, binge eating and purging) and schema modes was also explored.

Materials and methods

Participants

The sample comprised 649 participants [181 males (27.9%) and 468 females (72.1%)] aged from 18 to 91 years (mean = 40.66, SD = 18.27). The study was open to individuals (1) aged over 18 years old, (2) who were Italian-speaking and that (3) signed digital informed consent to participate in the study. Exclusion criteria included the inability to complete the questionnaire due to visual or cognitive impairments. Participation was voluntary, and respondents did not receive remuneration.

Sample size calculation

Sample size calculation was based on two recommendations: first, that 500 or more observations can be considered "very good" for conducting a confirmatory factor analyses [14]; second, using the rule of ten subjects per item [15].

Measures

Demographics Information including age, gender, education, relationships, and employment status were collected.

Biomedical data Data on height and weight were registered and *BMI* was calculated as weight (kg) divided by height squared (m^2). Participants were also asked to report on the presence of existing diagnosis of eating disorders through a multiple choice question ("Have you ever been diagnosed with one of the following eating disorder?") [16].

The Italian version of the Eating Disorder Examination Questionnaire (EDE-Q) [17] The EDE-Q 6.0 is a 28-item self-report measure of ED attitudes psychopathology and behaviours in both community and clinical populations. The questions concern the frequency of key behavioural features of EDs in which the person engages over the preceding 28 days. The questionnaire is scored on a 7-point Likert scale (0–6), rated using four subscales (restraint—R; eating concern—EC; shape concern—SC; and weight concern—WC) and a global score.

The EDE-Q has generally received support as an adequately reliable and valid measure of eating-related pathology [13]. Similarly, in the present sample, the dimensions of the EDE-Q have demonstrated acceptable internal

consistency (R-α = 0.804; EC-α = 0.822; SC-α = 0.900; WC-α = 0.800; General/Total-α = 0.944).

The Italian version of schema mode inventory for eating disorders—short form (SMI-ED-SF) The item-pool ($n = 64$) for the new SMI-ED-SF was first created independently by two clinicians/researchers specialized both in ST and in the treatment of ED (authors GP and SS), who listed the items under each of the 16 modes in order of relevance in observance of the ST conceptualization for EDs.

Simultaneously, and blinded from the other authors, a third researcher (not specialized in ST; author AR) identified those items showing higher factor loading for each dimension of the original SMI-ED [13]. Conclusions from the authors were matched and discussed until agreement on the final set of items for the SMI-ED-SF was reached. Four items (three general, and one EDs-specific statement—where applicable) per mode were retained—thus to overcome the limitation of the previous version of the tool—where the number of items was highly heterogeneous between modes.

The SMI-ED is a 190-item self-report questionnaire with sixteen different modes clustered thematically: (A) five innate child modes (1. vulnerable child—VC, 2. angry child—AC, 3. enraged child—EC, 4. impulsive child—IC and 5. undisciplined child—UC); (B) two maladaptive (internalized/introject) modes (6. punitive mode—PM and 7. demanding mode—DM); (C) seven maladaptive coping modes (8. compliant surrenderer—CS, 9. helpless surrenderer—DS, 10. detached protector—Det.P, 11. detached self-soother—Det.SS, 12. self-aggrandizer—SA, 13. bully and attack—BA 14. eating disorder overcontroller—EDO); and (D) two healthy factors (15. happy child—HC and 16. healthy adult—HA). Notably, two modes (IC and EC) only included items retrieved from the original version of the SMI [18], while the HS and the EDO modes exclusively consisted of new ED-specific statements.

The SMI-ED revealed acceptable internal consistency, with Cronbach's alpha coefficients ranging from 0.807 (Det. SS) to 0.976 (PM) across subscales ($\text{mean}_{\alpha\text{-factors}} = 0.914$; $\text{SD}_{\alpha\text{-factors}} = 0.048$).

Contrary to its full-length version—in which the number of items between scales varies from 5 (DS) to 20 (VC)—a fixed list of four statements was ensured for each of the SMI-ED-SF subscales ($n = 16$). Specifically, except for those modes only including either items retrieved from the original SMI or consisting of EDs-specific statements, the remaining subscales comprised three general statements and one item representative of the ED population.

Consistent with the previous versions of the tool [13, 18], items were scored on a six-point Likert scale ranging from 0 ("never or hardly ever") to 5 ("all of the time") and the score for each mode was computed dividing the sum scores by the number of items in each subscale. The higher the score, the more frequent were the manifestations of the modes.

Translation and cross-cultural adaptation

The SMI-ED-SF was independently translated from the original English version into Italian by two bilingual experts in the field, with one of them also having good knowledge of the measure. Any inconsistencies were revised and adjusted by a third investigator independent from the study using culturally and clinically fitting expressions. Also, to ensure conceptual equivalence between translations, a blind back translation of the Italian version of the SMI-ED-SF into English was conducted by an independent bilingual translator. Prior to the main study, the approved Italian version of the questionnaire was trialed with a random sample of 15 patients with EDs and 23 non-clinical participants, to assess item comprehensibility for the target population. No further adjustment was required.

Procedure

This study was completed entirely online, hosted by the questionnaire tool Qualtrics. Recruitment advertisements included a link placed on the main social networks (i.e., Facebook, Twitter) and websites of various local clinical centers specialized in the treatment and rehabilitation of EDs in Italy. In addition, flyers were placed around University campuses and in clinical waiting rooms of local ED services. The initial page contained a detailed description of the study, inclusion, and exclusion criteria along with any potential risks that may occur as a result of participation. Subjects were then asked to acknowledge they had read the terms and conditions and were aware of any potential risks by signing an informed consent form. Following informed consent, participants were asked to report demographic information and to answer the study questionnaires. After completing the survey, they were given access to a debriefing page of the study aims, and methodology, and received contact details for support services.

Statistical analyses

To test the factorial structural model of the SMI-ED-SF a Confirmatory Factor Analysis (CFA) was performed using 'lavaan' package [19, 20] for R software (R-core project [21, 22]). All the other statistical analysis were carried out with SPSS software (version 20.0, SPSS Inc., Bologna, Italy) [23].

As reported in Table 2, items' descriptive statistics showed a non-normal distribution of some indicators. Therefore, in line with the previous study [13], the robust maximum likelihood method (MLM) [24–27] was chosen as estimator for the CFA. The MLM is a robust variant of the Maximum likelihood [27] that provides robust standard errors and is also referred to as the Satorra–Bentler Chi

square (S–Bχ^2) [19, 28, 29] to assess the model fit. Other fit indexes used to assess the model fit [30] were: the root mean square error of approximation (RMSEA) [31, 32], the comparative fit index (CFI) [33], and the standard root mean square residual (SRMR) [27], and the ratio of S–Bχ^2 to the degrees of freedom (*df*) [34]. A S–Bχ^2 test non-significant is desirable [35]. The RMSEA expresses fit per degrees of freedom of the model, with values lower than 0.08 suggesting an acceptable model fit [36] and values below 0.05 indicating a good fit [37]. The CFI designates the amount of variance and covariance accounted by the model compared with a baseline model, with values between 0.90 and 0.95 considered an acceptable fit [38, 39], and values > 0.95 indicating a good fit [36].

However, Kenny and McCoach mathematically demonstrate that a higher number of indicators analyzed negatively affects this fit index [40–42]. The SRMR derives from the residual correlation matrix and represents the average discrepancy between the correlations observed in the input matrix and those predicted by the model [27, 38]. A cutoff value higher than 0.08 is considered good [26, 36]. Also, the χ^2/df ratio is considered as an easily computable measure of fit [26, 43], and a χ^2/df ratio value of 3 or less indicates good fit [44–47].

The Cronbach's alpha coefficient was used as measure of internal consistency for each SMI-ED-SF subscale—and values higher than 0.7 are deemed acceptable [48]. However, considering the differences in the magnitude of SMI-ED-SF's factor loadings, Cronbach's alpha was supported by Raykov's maximal reliability (MR) [49] and the Bentler's "Model-Based Internal Consistency Coefficient" (MBICC) [50]. These two indices were, respectively, chosen as measures of internal consistency of each single factor and multidimensional (overall) reliability: values higher than 0.6 suggest good reliability [51].

In addition, a MANCOVA was conducted to assess for possible statistical differences between the disordered eating subgroups simultaneously, on the SMI-ED-SF subscales, while adjusting for differences in age and gender.

Results

Sample characteristics

Participants' self-reported BMI ranged from 13.71 to 65.31 (mean = 28.26; SD = 10.54), with 15.7% of the sample having a BMI below 18.5 and 38.4% of the respondents having a BMI above 30.1.

Of 649 participants, 46 self-reported a diagnosis of anorexia nervosa (AN), 31 were diagnosed with bulimia nervosa (BN), 64 suffered from binge eating disorder (BED), and 58 declared eating disorders not otherwise specified (EDNOS)—while the remaining 450 participants did not self-report a diagnosis of EDs. Descriptive statistics are presented in Table 1.

Structural validity

Item analysis revealed a non-perfect normal distribution, with Kolmogorov–Smirnov and Shapiro–Wilk tests being significant ($p < .001$). Skewness ranged between − 1.18 and 2.76 ($mean_{sk} = 0.79$, $SD_{sk} = 0.81$), and kurtosis ranged between − 1.03 and 8.09 ($mean_k = 0.64$, $SD_k = 2.01$) (Table 2).

In line with the SMI-ED validation study [13], results from the CFA suggested an acceptable 16-correlated-factors solution for the SMI-ED-SF, despite not all the model's fit indexes reaching the desired value [36]. Indeed, the Satorra–Bentler Chi square model for fit was statistically significant [S–Bχ^2 (1832) = 3324.799; $p < .001$] and the CFI value did not achieve the threshold (CFI > 0.90 [38, 39]: CFI = 0.880). However, the RMSEA showed a good approximation fit of the model to the data [RMSEA = 0.045 (90% CI from 0.043 to 0.048), p(RMSEA < 0.05) = 1], and the SRMR also accounted for the goodness of the model (SRMR = 0.066 [36]). By dividing the χ^2 for the degrees of freedom (*df*) of the model [34, 36], the model further resulted acceptable ($\chi^2/df = 1.81$; < 3) [26].

As reported in Table 2, each item loaded significantly on its associated factor ($p < .001$), $mean_{loadings} = 0.698$; $SD_{loadings} = 0.122$; ranging from 0.339 (item#22) to 0.901 (item#11). Correlations between the 16 factors ranged from |0.065| to |0.654|; $mean_{r\text{-factors}} = 0.238$; $SD_{r\text{-factors}} = 0.297$ (Table 3).

Concurrent validity: correlation between SMI-ED-SF factors and eating disorder variables

Most SMI-ED-SF factors were significantly associated (ranging from |0.088| to |0.855|) with the EDE-Q subscales and ED symptoms (Table 4). In line with the original SMI-ED the adaptive modes (happy child and healthy adult) were negatively correlated with all the ED variables.

Correlation between SMI-ED-SF factors, gender, age, and BMI

Most of the SMI-ED-SF factors were not significantly associated with gender, age and BMI (Table 5). Regarding gender, significant associations ranged from |0.084| (angry child) to |0.235| (vulnerable child). Considering age, statistically significant correlations ranged from |0.079| (happy child) to |0.197| (helpless surrenderer). Also, significant correlations between the SMI-ED-SF factors and BMI ranged

Table 1 Descriptive statistics for the EDE-Q 6.0 subscales

	Overall sample ($n=649$)		AN ($n=46$)		BN ($n=31$)		BED ($n=64$)		EDNOS ($n=58$)		No diagnosis ($n=450$)		Statistics[a]	p value
Weight—in kg (mean; SD)	82.21	30.94	50.69	13.55	75.66	24.87	107.32	23.56	103.67	29.82	79.53	29.56	$H=143.227$	<0.001
Height—in m (mean; SD)	1.67	0.08	1.64	0.08	1.66	0.07	1.66	0.08	1.64	0.11	1.67	0.08	$H=10.276$	0.036
BMI (mean; SD)	28.26	10.54	18.23	3.14	27.13	9.37	38.17	7.40	37.27	10.41	26.81	9.77	$H=131.005$	<0.001
Age (mean; SD)	40.66	18.27	26.46	9.11	40.97	10.59	51.27	17.86	51.59	16.01	39.17	17.98	$H=76.277$	<0.001
Gender (*n; %*)													$V=0.187$	<0.001
Male	181	27.9%	3	6.5%	1	3.2%	19	29.7%	17	29.3	141	31.3%		
Female	468	72.1%	43	93.5%	30	96.8%	45	70.3%	41	70.7	309	68.7%		
Relationships status (*n*; %)													$V=0.149$	<0.001
Single/never married	357	55.0%	39	84.8%	18	58.1%	24	37.5%	15	25.9%	261	58.0%		
In a de-facto relationship	42	6.5%	2	4.3%	3	9.7%	6	9.4%	2	3.4%	29	6.4%		
Married	175	27.0%	4	8.7%	5	16.1%	25	39.1%	26	44.8%	115	25.6%		
Separated/divorced	52	8.0%	0	0.0%	4	12.9%	6	9.4%	10	17.2%	32	7.1%		
Widowed	23	3.5%	1	2.2%	1	3.2%	3	4.7%	5	8.6%	13	2.9%		
Education status (*n*; %)													$V=0.114$	0.006
Elementary school	21	3.2%	0	0.0%	0	0.0%	3	4.7%	6	10.3%	12	2.7%		
Middle school	114	17.6%	11	23.9%	6	19.4%	18	28.1%	14	24.1%	65	14.4%		
High school	381	58.7%	30	65.2%	16	51.6%	37	57.8%	29	50.0%	269	59.8%		
Bachelor's degree	127	19.6%	5	10.9%	9	29.0%	6	9.4%	8	13.8%	99	22.0%		
Postgraduate degree/PhD	6	0.9%	0	0.0%	0	0.0%	0	0.0%	1	1.7%	5	1.1%		
Employment status (*n*; %)													$V=0.189$	<0.001
Student	253	39.0%	30	65.2%	8	25.8%	7	10.9%	9	15.5%	199	44.2%		
Employees	149	23.0%	3	6.5%	10	32.3%	17	26.6%	14	24.1%	105	23.3%		
Freelancers	55	8.5%	2	4.3%	3	9.7%	6	9.4%	4	6.9%	40	8.9%		
Homemaker	36	5.5%	0	0.0%	3	9.7%	10	15.6%	6	10.3%	17	3.8%		
Unemployed	63	9.7%	10	21.7%	3	9.7%	8	12.5%	10	17.2%	32	7.1%		
Retired	93	14.3%	1	2.2%	4	12.9%	16	25.0%	15	25.9%	57	12.7%		

AN Anorexia nervosa, *BN* bulimia nervosa, *BED* binge-eating disorder, *EDNOS* eating disorder not otherwise specified

[a]Due to variable sample sizes from each group and the non-normal distributions of some variables, Cramér's V and Kruskal–Wallis's tests were performed to assess associations across socio-demographics variables

Table 2 Factor loading of the SMI-ED-SF items

Factor	Item	Item descriptive statistics							CFA	
		Mean	Median	SD	Sk	*K*	%Min (%)	%Max (%)	λ	R^2
VC—vulnerable child										
	Item1	1.568	1	1.294	0.600	−0.284	24.5	2.3	0.707	0.500
	Item2	1.156	1	1.391	1.134	0.432	45.6	3.7	0.643	0.414
	Item3	1.017	1	1.192	1.158	0.804	45.1	1.3	0.869	0.754
	Item4	1.173	1	1.215	0.959	0.359	37.7	1.3	0.830	0.689
AC—angry child										
	Item5	1.188	1	1.368	1.026	0.206	44.0	3.0	0.684	0.468
	Item6	1.406	1	1.257	0.752	0.106	29.1	2.5	0.693	0.481
	Item7	1.585	1	1.392	0.648	−0.362	27.5	3.9	0.848	0.719
	Item8	0.875	0	1.162	1.488	1.958	51.4	1.9	0.698	0.487
EC—enraged child										
	Item9	0.447	0	0.951	2.593	6.908	75.0	0.8	0.682	0.465
	Item10	0.928	1	1.147	1.316	1.362	47.8	1.1	0.873	0.762
	Item11	0.671	0	1.034	1.822	3.409	60.4	1.0	0.901	0.811
	Item12	1.259	1	1.141	0.989	0.943	28.4	1.7	0.731	0.535
IC—impulsive child										
	Item13	1.531	1	1.264	0.801	0.052	21.1	2.2	0.753	0.568
	Item14	0.917	1	1.182	1.503	1.891	48.0	1.5	0.779	0.607
	Item15	1.217	1	1.199	1.062	0.744	32.1	1.6	0.820	0.673
	Item16	1.831	2	1.361	0.510	−0.373	18.2	4.9	0.591	0.349
UC—undisciplined child										
	Item17	1.261	1	1.286	1.014	0.438	34.5	2.5	0.782	0.611
	Item18	1.396	1	1.273	0.697	−0.271	30.2	1.4	0.851	0.724
	Item19	1.089	1	1.196	1.141	0.888	40.1	1.4	0.557	0.310
	Item20	1.535	1	1.353	0.766	−0.121	25.8	3.6	0.609	0.371
HC—happy child										
	Item21	3.136	3	1.393	−0.425	−0.623	4.5	18.8	0.675	0.456
	Item22	2.911	3	1.367	−0.196	−0.708	4.7	14.2	0.339	0.115
	Item23	2.791	3	1.345	−0.221	−0.616	6.0	10.2	0.864	0.746
	Item24	2.894	3	1.257	−0.337	−0.479	4.0	8.2	0.780	0.608
PM—punitive mode										
	Item25	0.740	0	1.137	1.713	2.412	59.5	0.9	0.650	0.422
	Item26	0.577	0	1.007	2.199	5.198	65.8	1.2	0.767	0.588
	Item27	0.435	0	0.958	2.762	8.028	75.8	1.2	0.839	0.704
	Item28	0.445	0	0.961	2.737	8.087	75.0	1.5	0.861	0.742
DM—demanding mode										
	Item29	1.426	1	1.463	0.943	0.009	34.3	5.5	0.703	0.494
	Item30	1.145	1	1.339	1.259	0.974	41.8	3.9	0.712	0.507
	Item31	2.580	3	1.501	−0.034	−0.964	9.6	12.4	0.396	0.157
	Item32	2.699	3	1.484	−0.044	−1.010	7.0	13.8	0.461	0.212
HA—healthy adult										
	Item33	3.808	4	1.186	−1.179	1.293	2.5	32.1	0.669	0.447
	Item34	2.938	3	1.296	−0.330	−0.400	4.8	11.5	0.605	0.366
	Item35	3.270	4	1.398	−0.622	−0.411	4.6	20.8	0.794	0.630
	Item36	3.651	4	1.193	−0.868	0.495	2.0	27.3	0.732	0.536
CS—compliant surrender										
	Item37	2.305	2	1.385	0.117	−0.776	10.5	6.2	0.560	0.314
	Item38	1.553	1	1.319	0.612	−0.354	25.9	2.5	0.775	0.601
	Item39	2.137	2	1.488	0.195	−0.949	16.8	6.3	0.715	0.511

Table 2 (continued)

Factor	Item	Item descriptive statistics							CFA	
		Mean	Median	SD	Sk	*K*	%Min (%)	%Max (%)	λ	R^2
	Item40	1.223	1	1.446	1.062	0.144	44.7	4.0	0.724	0.524
Det.P—detached protector										
	Item41	1.526	1	1.440	0.759	−0.336	30.4	4.2	0.749	0.561
	Item42	1.503	1	1.458	0.778	−0.346	32.1	4.5	0.650	0.423
	Item43	0.836	0	1.171	1.633	2.475	54.0	2.2	0.730	0.533
	Item44	0.679	0	1.129	1.815	2.809	64.9	1.1	0.674	0.454
Det.SS—detached self-soother										
	Item45	1.714	1	1.611	0.615	−0.815	30.8	7.3	0.659	0.434
	Item46	2.124	2	1.499	0.236	−0.952	18.8	6.6	0.744	0.553
	Item47	1.368	1	1.447	0.909	−0.103	37.6	4.3	0.631	0.398
	Item48	2.371	2	1.445	0.143	−0.844	10.4	9.0	0.676	0.457
SA—self-aggrandizer										
	Item49	2.224	2	1.285	0.152	−0.615	9.0	4.0	0.511	0.262
	Item50	1.755	2	1.476	0.556	−0.628	24.4	5.6	0.365	0.133
	Item51	1.103	0	1.495	1.195	0.271	54.3	4.4	0.601	0.362
	Item52	2.133	2	1.446	0.128	−0.935	16.3	5.1	0.543	0.294
BA—bully and attack										
	Item53	0.715	0	1.112	1.772	2.705	59.8	1.0	0.710	0.504
	Item54	0.675	0	0.945	1.460	1.848	57.2	0.3	0.610	0.372
	Item55	0.962	0	1.266	1.360	1.185	50.9	2.0	0.729	0.532
	Item56	1.071	1	1.307	1.284	1.033	45.5	3.0	0.628	0.395
HS—helpless surrenderer										
	Item57	2.079	2	1.528	0.328	−0.902	17.7	8.2	0.599	0.359
	Item58	2.764	3	1.482	−0.093	−0.915	7.3	15.7	0.717	0.514
	Item59	2.083	2	1.470	0.337	−0.732	16.4	7.7	0.614	0.377
	Item60	1.904	2	1.515	0.443	−0.791	21.7	7.0	0.800	0.641
EDO—eating disorder overcontroller										
	Item61	1.355	1	1.517	0.887	−0.364	42.0	4.2	0.753	0.567
	Item62	1.870	2	1.678	0.463	−1.027	29.7	9.8	0.788	0.621
	Item63	1.284	1	1.548	0.993	−0.210	46.5	5.1	0.876	0.768
	Item64	0.974	0	1.361	1.370	0.955	55.0	2.8	0.776	0.603

The scale revealed acceptable internal consistency, with Cronbach's Alpha coefficients ranging from 0.635 (SA) to 0.873 (EC and EDO); $\text{mean}_{\alpha\text{-factors}} = 0.787$; $\text{SD}_{\alpha\text{-factors}} = 0.06$. Furthermore, the Raykov's MR ranged from 0.664 (SA) to 0.905 (EC); $\text{mean}_{\text{MR-factors}} = 0.816$ $\text{SD}_{\text{MR-factors}} = 0.06$—suggesting each scale to be adequately reliable (Table 3). Also, the Bentler's MBICC was equal to 0.951—indicating a good overall reliability of the scale

from |0.099| (self-aggrandizer) and |0.168| (eating disorder overcontroller).

Mode scores across disordered eating subscales

While controlling for age and gender as possible confounding variables, the MANCOVA revealed a significant difference between the presence of a self-reported diagnosis of ED and most of the SMI-ED-SF subscales: Wilks's $\Lambda = 0.638$, $F = 4.587$, $p < .001$, partial $\eta^2 = 106$. No differences emerged between ED diagnoses and the enraged child mode measured by the SMI-ED-SF. Also, to test differences between groups within the SMI-ED-SF subscales, ANCOVAs with focused contrasts were conducted for each dependent variable (Table 6).

Participants with no self-reported diagnosis of EDs showed lower means for each maladaptive mode as well as higher means for the adaptive modes, thus suggesting the goodness of the SMI-ED-SF in discriminating between the clinical and the general population.

Table 3 Mean values, standard deviations, correlations between subscales of the SMI-ED-SF and reliability of each subscale (Cronbach's Alpha and MR)

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Alpha	MR
1	VC	1.24	1.05	–																0.829	0.875
2	AC	1.26	1.04	0.617	–															0.813	0.842
3	EC	0.82	0.91	0.363	0.654	–														0.873	0.905
4	IC	1.37	1.01	0.419	0.523	0.607	–													0.823	0.845
5	UC	1.32	0.99	0.461	0.462	0.339	0.502	–												0.786	0.839
6	HC	2.93	1.01	−0.479	−0.351	−0.167	−0.142	−0.251	–											0.748	0.845
7	PM	0.55	0.85	0.541	0.440	0.226	0.277	0.347	−0.375	–										0.856	0.881
8	DM	1.96	1.05	0.384	0.317	0.211	0.189	0.118	−0.152	0.416	–									0.690	0.711
9	HA	3.42	0.99	−0.426	−0.323	−0.196	−0.181	−0.288	0.528	−0.429	−0.065*	–								0.793	0.809
10	CS	1.81	1.10	0.423	0.295	0.128	0.192	0.390	−0.281	0.450	0.351	−0.249	–							0.784	0.804
11	Det.P	1.14	1.03	0.508	0.478	0.305	0.316	0.423	−0.380	0.526	0.312	−0.388	0.544	–						0.785	0.799
12	Det.SS	1.89	1.15	0.501	0.533	0.305	0.343	0.333	−0.262	0.390	0.366	−0.222	0.357	0.425	–					0.769	0.778
13	SA	1.80	0.95	0.381	0.446	0.376	0.368	0.292	−0.252	0.261	0.373	−0.148	0.231	0.367	0.440	–				0.635	0.664
14	BA	0.87	0.90	0.333	0.487	0.442	0.345	0.296	−0.266	0.304	0.276	−0.229	0.226	0.390	0.361	0.542	–			0.753	0.772
15	HS	2.20	1.16	0.539	0.568	0.403	0.425	0.467	−0.312	0.369	0.342	−0.273	0.442	0.430	0.546	0.503	0.449	–		0.778	0.800
16	EDO	1.37	1.30	0.446	0.387	0.225	0.311	0.271	−0.173	0.362	0.385	−0.180	0.275	0.336	0.520	0.393	0.291	0.374	–	0.873	0.886

All correlations are significant at $p < .001$, except for *($p > .05$; ns.)

VC Vulnerable child, *AC* angry child, *EC* enraged child, *IC* impulsive child, *UC* undisciplined child, *HC* happy child, *PM* punitive mode, *DM* demanding mode, *HA* healthy adult, *CS* compliant surrender, *Det.P* detached protector, *Det.SS* detached self-soother, *SA* self-aggrandizer, *BA* bully and attack, *HS* helpless surrenderer, *EDO* eating disorder overcontroller, *MR* maximum residual

Table 4 Correlations between SMI-ED-SF subscales

	Times OE[†]	Times bingeing[†]	Days bingeing[†]	Vomit[†]	Laxatives[†]	Exercise[†]	Restraint[‡]	Eating concerns[‡]	Shape concerns[‡]	Weight concerns[‡]	Global[‡]
VC	0.291	0.477	0.377	0.228	0.333	0.377	0.368	0.530	0.449	0.506	0.536
AC	0.404	0.569	0.456	0.281	0.357	0.414	0.272	0.424	0.392	0.413	0.425
EC	0.504	0.572	0.538	0.366	0.320	0.290	0.144	0.219	0.178	0.198	0.205
IC	0.835	0.788	0.855	0.761	0.450	0.449	0.203	0.269	0.243	0.261	0.282
UC	0.367	0.452	0.451	0.360	0.814	0.853	0.157	0.385	0.322	0.316	0.330
HC	−0.074[§]	−0.234	−0.145	−0.022[§]	−0.195	−0.196	−0.238	−0.313	−0.273	−0.326	−0.352
PM	0.168	0.362	0.260	0.120	0.230	0.297	0.316	0.437	0.401	0.419	0.441
DM	0.088*	0.230	0.142	0.152	0.070[§]	0.068[§]	0.321	0.356	0.351	0.356	0.407
HA	−0.091*	−0.303	−0.209	−0.011	−0.192	−0.206	−0.202	−0.294	−0.229	−0.283	−0.290
CS	0.078*	0.264	0.186	0.100*	0.256	0.302	0.249	0.354	0.358	0.332	0.375
Det.P	0.200	0.394	0.318	0.126	0.316	0.341	0.286	0.407	0.356	0.391	0.412
Det.SS	0.258	0.351	0.300	0.211	0.249	0.296	0.358	0.471	0.445	0.466	0.500
SA	0.324	0.338	0.287	0.249	0.231	0.295	0.278	0.346	0.329	0.331	0.371
BA	0.302	0.327	0.313	0.190	0.261	0.289	0.230	0.317	0.215	0.240	0.260
HS	0.332	0.432	0.363	0.263	0.349	0.391	0.301	0.453	0.404	0.407	0.451
EDO	0.210	0.333	0.266	0.214	0.218	0.249	0.490	0.527	0.557	0.563	0.613

All correlations are significant at $p < .001$, except for * ($p < .025$) and [§]($p > .05$; *ns*)

Times OE Over the past 28 days, how many TIMES have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?

Times bingeing On how many of these TIMES did you have a sense of having lost control over your eating (at the time that you were eating)?

Days bingeing Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)?

Vomit Over the past 28 days, how many TIMES have you made yourself sick (vomit) as a means of controlling your shape or weight?

Laxatives Over the past 28 days, how many TIMES have you taken laxatives as a means of controlling your shape or weight?

Exercise Over the past 28 days, how many TIMES have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape or amount of fat, or to burn off calories?

VC Vulnerable child, *AC* angry child, *EC* enraged child, *IC* impulsive child, *UC* undisciplined child, *HC* happy child, *PM* punitive mode, *DM* demanding mode, *HA* healthy adult, *CS* compliant surrender, *Det.P* detached protector, *Det.SS* detached self-soother, *SA* self-aggrandizer, *BA* bully and attack, *HS* helpless surrenderer, *EDO* eating disorder overcontroller

[†]EDs symptoms

[‡]EDE-Q subscales

Table 5 Correlations between SMI-ED-SF subscales, gender, age, and BMI across EDs

	Gender	Age	BMI
VC	0.235***	−0.154***	−0.155**
AC	0.084*	−0.074	−0.024
EC	0.022	−0.128**	−0.110*
IC	0.064	−0.063	−0.115*
UC	0.034	0.058	0.050
HC	−0.063	0.079*	0.074
PM	0.038	0.011	−0.019
DM	0.009	−0.050	−0.049
HA	−0.108**	0.109**	0.109*
CS	0.071	0.064	−0.007
Det.P	0.005	−0.011	0.009
Det.SS	0.121**	−0.111**	−0.002
SA	−0.030	−0.167***	−0.099*
BA	−0.120**	−0.119**	−0.070
HS	0.229***	−0.197***	−0.164***
EDO	0.124**	0.122**	0.168**

Associations between SMI-ED-SF subscales and gender were computed with point-biserial (polychoric) correlations; whereas, associations regarding SMI-ED-SF subscales, age and BMI were calculated on Pearson's product–moment correlation

*$p < .050$; **$p < .010$; ***$p < .001$

Discussion

This study tested the psychometric properties of the shorter version of the Schema Mode Inventory for disordered eating both for the general population and a clinical sample, in Italy.

Findings confirmed an adequate fit for the 16-factor model, with moderate intercorrelations between subscales. However, the Satorra-Bentler Chi square was statistically significant and the CFI values did not achieve the desired cutoff score (CFI > 0.90 [38, 39]: CFI = 0.880). They may have been affected by the sample size (i.e., Chi square [34, 35, 52–54]) and the number of considered indicators, (i.e., CFI [36, 40–42, 46, 54–56]) respectively, but, since both the SRMR and RMSEA accounted for the goodness of the model, this is not reason for concern [40]. Also, internal consistency within subscales was high, and the scale showed good overall reliability.

As expected, disordered eating behaviours were positively correlated with most of the negative coping modes, and negatively related to the healthy modes (healthy adult and happy child). Specifically, the overcontroller mode and the helpless surrenderer dimensions (explicitly designating the presence of disordered eating patterns) showed moderate-to-high correlations with the eating/weight/shape concerns subscales of the EDE-Q, as well as with the EDE-Q global score. Consistently, higher mean scores for the Healthy Modes were noticed in respondents with no self-reported diagnosis of EDs.

Findings from this study reflect those observed by testing the psychometric properties of the Schema Mode Inventory for eating Disorders (SMI-ED) [13]—the adapted version of the Schema Mode Inventory (SMI) for the measurement of mode states within a population with self-reported disordered eating behaviours [18]—but overcome some of its methodological and practical limitations. In fact, unlike for the SMI-ED validation study, participants were recruited from both clinical and non-clinical populations, thus supporting the discriminatory power of the tool and its ability to identify individuals at risk/with disordered eating behaviours. By assessing the psychometric proprieties of the questionnaire in Italian—and demonstrating their goodness of fit—further evidence was also reached for both its construct and external validity. Moreover, a meaningful item reduction resulting in the development of a new shorter instrument in Italian increases the scale usability for both clinical and research purposes.

Nonetheless, these results should be considered a first step in the validation process of the SMI-ED-SF, and as a promising starting point for future research on the topic. In fact, as the sample was purely recruited via online survey, it has its limitations. First, it was not possible to ensure gender homogeneity among respondents—although a smaller proportion of males is representative of the gender ratio usually found in clinical settings [57]. Also, a relatively low proportion of participants revealed binge eating behaviours compared with other dysfunctional eating patterns, and the percentage of respondents who had never been diagnosed with an ED doubled its counterpart. In addition, asking people to self-report an existing diagnosis of EDs may have led to under-represent both those with reduced capacity to acknowledge their ED patterns, and individuals with severe EDs but avoidant of support services.

Future studies should ideally include a larger percentage of males in the sample, and all ED subgroups should be adequately represented within the sample to more precisely determine whether specific profiles of schema modes exist within a given diagnostic group, and the degree to which this is statistically feasible. The measurement invariance between clinical and non-clinical populations should also be tested to ascertain whether the questionnaire is valid to measure schema modes in each group separately.

Conclusion

This scale is of significant value for clinicians and researchers in identifying and exploring mechanisms through which schema modes are expressed within the ED population—both quantitatively and qualitatively. In fact,—as the

Table 6 Mean (SD) for the ED diagnosis resulting from the MANCOVA

	AN ($n=46$) Mean (SD)	BN ($n=31$) Mean (SD)	BED ($n=64$) Mean (SD)	EDNOS ($n=58$) Mean (SD)	No diagnosis ($n=450$) Mean (SD)	F (4637)	η_p^2	Focused contrast[a]
VC	2.51 (1.23)	2.30 (1.27)	1.50 (1.07)	1.37 (1.11)	0.97 (0.82)	36.909	0.190	1 > 3**; 1 > 4***; 1 > 5; 2 > 3**; 2 > 4**; 2 > 5; 3 > 5; 4 > 5
AC	2.04 (1.01)	2.13 (1.13)	1.60 (1.14)	1.38 (1.21)	1.04 (0.90)	20.236	0.114	1 > 5; 2 > 4**; 2 > 5; 3 > 5; 4 > 5**
EC	1.05 (1.02)	1.05 (0.93)	0.94 (1.03)	0.75 (0.90)	0.76 (0.84)	2.317[§]	0.014	3 > 5*
IC	1.78 (1.13)	2.07 (1.14)	1.77 (1.20)	1.35 (1.04)	1.22 (0.90)	11.038	0.065	1 > 5; 2 > 4; 2 > 5; 3 > 4*; 3 > 5
UC	1.82 (1.25)	1.79 (0.87)	1.70 (1.10)	1.48 (0.86)	1.14 (0.91)	11.100	0.066	1 > 5; 2 > 5; 3 > 5; 4 > 5**
HC	2.16 (1.02)	2.16 (0.64)	2.66 (1.01)	2.80 (1.23)	3.13 (0.93)	17.933	0.102	1 < 4*; 1 < 5; 2 < 3***; 2 < 4***; 2 < 5; 3 < 5; 4 < 5**
PM	1.40 (1.64)	1.09 (1.13)	0.77 (0.94)	0.47 (0.73)	0.40 (0.60)	21.501	0.120	1 > 4*; 1 > 5; 2 > 4**; 1 > 5; 3 > 5
DM	2.74 (1.37)	2.48 (1.26)	2.02 (1.08)	1.87 (0.97)	1.85 (0.94)	10.310	0.061	1 > 5; 2 > 5
HA	2.70 (1.01)	2.83 (0.94)	3.39 (0.99)	3.43 (1.04)	3.55 (0.94)	9.459	0.057	1 < 3*; 1 < 4*; 1 < 5; 2 < 3*;2 < 4*; 2 < 5
CS	2.40 (1.30)	2.11 (1.25)	2.12 (1.19)	1.84 (1.05)	1.67 (1.03)	6.706	0.041	1 > 4***; 1 > 5; 3 > 5**
Det.P	1.94 (1.25)	1.69 (1.09)	1.32 (1.01)	1.23 (1.01)	0.97 (0.94)	13.947	0.081	1 > 4**; 1 > 5; 2 > 5; 3 > 5**
Det.SS	2.73 (1.11)	2.94 (1.04)	2.12 (1.18)	1.92 (1.13)	1.69 (1.08)	16.599	0.095	1 > 5; 2 > 3**; 2 > 4***; 2 > 5; 3 > 5***
SA	2.28 (1.02)	2.37 (1.04)	2.08 (0.92)	1.68 (0.87)	1.68 (0.90)	11.244	0.067	1 > 5; 2 > 4***; 2 > 5; 3 > 4**; 3 > 5
BA	1.15 (0.91)	1.17 (0.88)	0.94 (0.97)	0.79 (0.93)	0.81 (0.87)	3.902*	0.024	1 > 5**; 2 > 4*; 2 > 5**; 3 > 5*
HS	2.89 (1.13)	2.72 (1.19)	2.52 (1.20)	2.31 (1.17)	2.03 (1.10)	8.656	0.052	1 > 5; 2 > 5***; 3 > 5; 4 > 5**
EDO	2.70 (1.52)	2.64 (1.26)	1.85 (1.23)	1.54 (1.33)	1.05 (1.11)	33.089	0.174	1 > 4**; 1 > 5; 2 > 3**; 2 > 4***; 2 > 5; 3 > 5

All contrasts are significant at $p < .001$, except for ***($p < .005$), **($p < .020$), *($p < .050$) and [§] ($p > .050$; *ns*)

VC Vulnerable child, *AC* angry child, *EC* enraged child, *IC* impulsive child, *UC* undisciplined child, *HC* happy child, *PM* punitive mode, *DM* demanding mode, *HA* healthy adult, *CS* compliant surrender, *Det.P* detached protector, *Det.SS* detached self-soother, *SA* self-aggrandizer, *BA* bully and attack, *HS* helpless surrenderer, *EDO* eating disorder overcontroller

[a]Focused contrast with covariates (ANCOVAs) was performed to test potential differences between EDs (1. *AN* anorexia nervosa, 2. *BN* bulimia nervosa, 3. *BED* binge eating disorder, 4. *EDNOS* eating disorder not otherwise specified, 5. no diagnosis) and SMI-ED-SF dimensions. Age and gender were used as covariates

SMI-ED—the SMI-ED-SF not only provides information regarding modes that would not be otherwise accessible in the original SMI [18], but—because of its reduced number of items—it facilitates the capacity to make important links between ED symptoms and schema modes, and in developing individually tailored case conceptualizations and treatments.

In fact, although CBT is widely recognized as the gold standard intervention for adults with EDs, it is still restricted to the ineffective coping mechanisms maintaining the problem [58], without adequately addressing early life experiences often at the root of the painful or unhelpful ways of thinking, feeling and behaving typical of clients with EDs. Evidence supports the effectiveness of ST in facilitating behavioural change both through diminishing the emotional intensity of memories linked to EMS [and associated ED symptoms], alongside direct behavioural pattern-breaking. The development of a measure specifically aimed at facilitating a more precise measurement of mode states within the ED population will enable clinicians to provide more sophisticated conceptualizations and therapeutic opportunities for those with EDs, and to enhance long-term maintenance of the achieved results [10].

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Compliance with ethical standards

Conflict of interest The authors declare that there are no conflicts of interest.

Ethical approval The Medical Ethics Committee of Istituto Auxologico Italiano approved the study protocol and the informed consent process.

Research involving human participants and/or animals All procedures performed in studies were run in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Written informed consent was obtained from all participants. The Medical Ethics Committee of Istituto Auxologico Italiano approved the study protocol and the informed consent process.

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